Adaptive Management:

Hamilton Wetland Restoration Project

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Adaptive Management (AM): HWRP

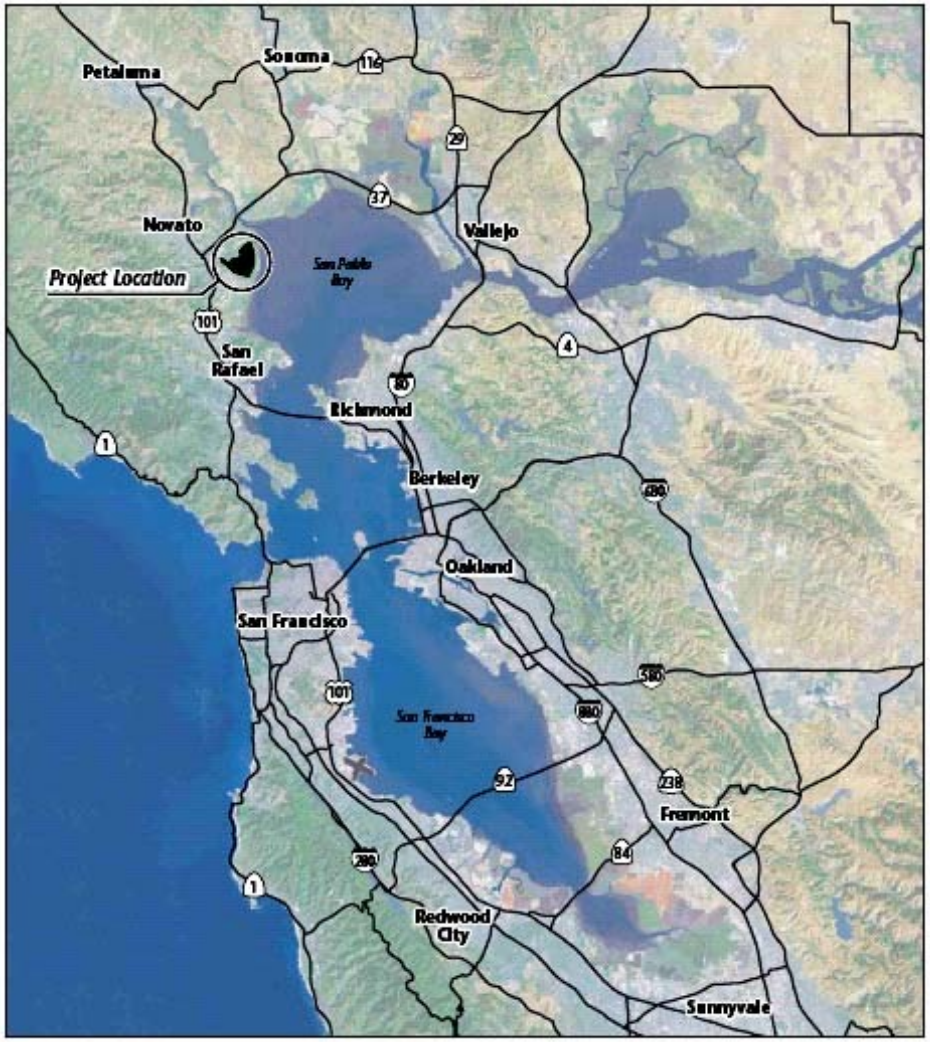
- Project overview
- Where adaptive management fits in the restoration process
- Project-specific impetus for adaptive management
- Development, status
- Personal thoughts on adaptive management in Corps restoration projects

Project Background

- Site was originally wetland/intertidal salt marsh
- Diked and drained for agricultural use in mid- 19th century
- Ag lands converted to Army Air Base in 1932
- BRAC in 1980's
- Project intent
  - "ecosystem restoration"
  - dredged material disposal

  ≈ 630 ac of wetland

  ≈1000 ac total project
- Sponsor: California State Coastal Conservancy



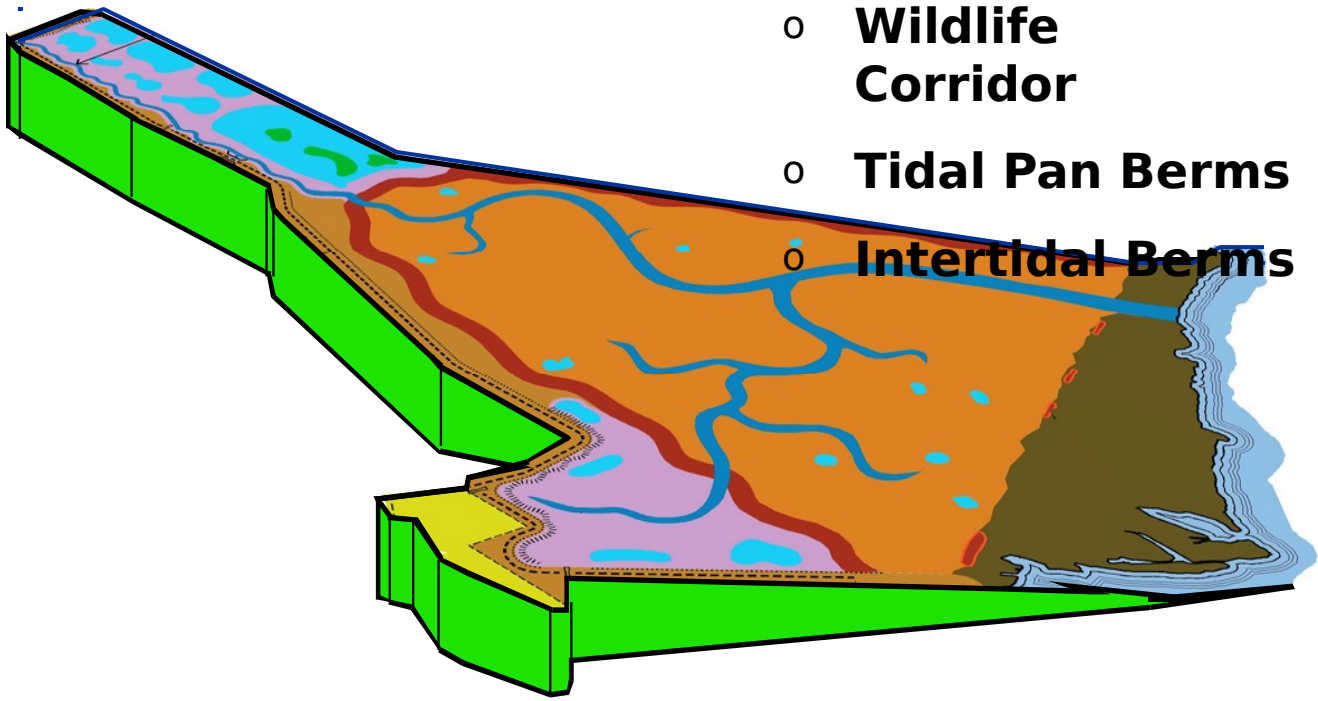
Project Goals

- "Ecosystem restoration goals" developed by sponsor/stakeholders
  - Create a diverse array of wetlands and habitat types
  - Replace habitat/function of disused agricultural fields for shorebirds
  - Sustainability
    - minimal site maintenance,
    - provide habitat independent of sea-level rise
  - Biodiversity, wildlife, TES
- Placement site for dredged material

Project Goals

Three broad habitat types:

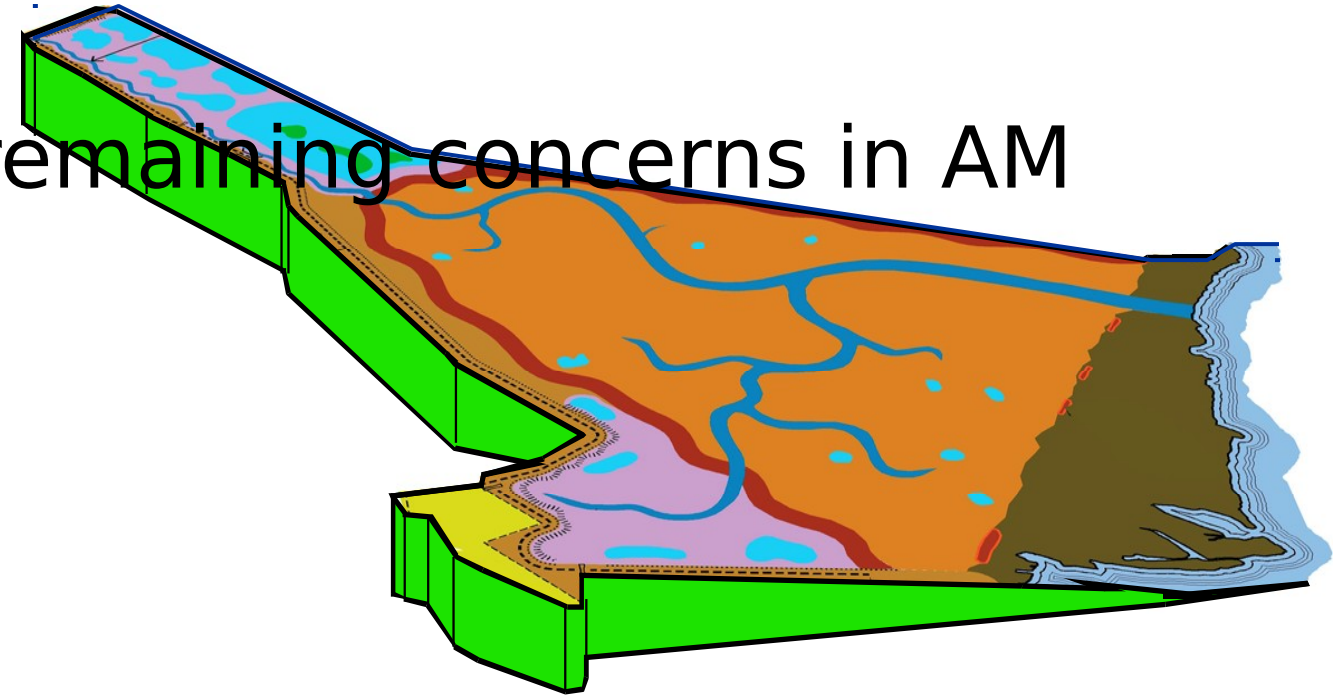
- Intertidal marsh and mudflat
- “Seasonal” wetland
- Upland

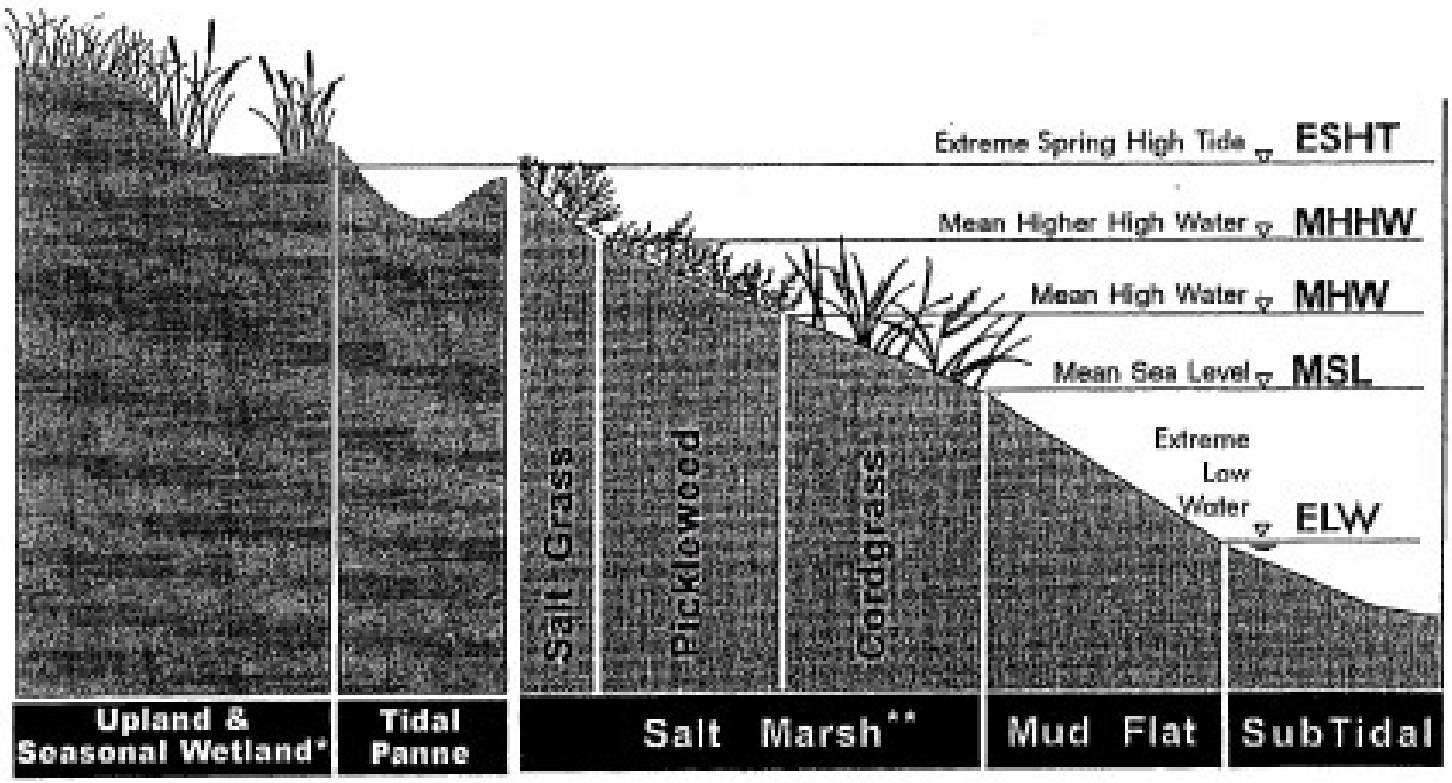


- **Seasonal Wetland**
- **Tidal Wetland**
- **Wildlife Corridor**
- **Tidal Pan Berms**
- **Intertidal Berms**

Project Goals

- Engineering response to goals/objectives
  - Ponds at various levels
  - Appropriate salinity (rain, runoff, tidal inputs)
- Address remaining concerns in AM plan





* Upland, seasonal wetland, and non-tidal wetland may be lower than shown if levees artificially prevent tidal inundation.

** Marsh ponds appear on mature marsh plains at local high points in the marsh.

Note: Tidal terms are defined in Appendix B.

Schematic of Habitats by Tide Levels

“Planning” Ecosystem Restoration: the (ecology) textbook sequence

- Goals
- (Site “vision”/Conceptual model)
- Objectives
- Success criteria
- Monitoring plan
- Adaptive management plan

Adaptive Management definition ?

The (ecology) textbook perspective

- Analogous to a formal scientific experiment in which the equivalent of “null” and alternative hypotheses set up which correspond to success criteria based on objectives
- Quantifiable
- Pre-determined actions established
- Not “trial and error”
- Not monitoring with unidentified targets with the vague possibility of fixing it later

Ecologists' Perspective: Rationale for AM

- Many populations are highly variable, beyond our 'intuitive' understanding
- Coastal (e.g., seagrass) populations vary by 20x on an annual basis
- Most functions are not quantitatively well known
- Restoration is far from an exact science with good predictability – we can establish plant populations with a reasonable degree of predictability. Bird populations will follow plant and water…
- Little indication that the presence of birds indicates "quality" habitat
- Some populations (algal, fungal, some inverts) may take decades even though plants, birds, and fish look o.k.

Adaptive Management

A process for anticipating and measuring how well a restoration plan achieves its predicted targets or desired objectives, and for using these assessments as a basis for making improvements in the design or operations of the plan.

Provides a means for continually reducing the levels of uncertainty, and for adjusting to unexpected responses, by refining the design of the restoration plan in response to improving information databases (including the learning that comes from monitoring and researching actual system responses).

SAJ definition for Florida

Key Elements of Adaptive Management

- Anticipation: Maximize flexibility of design & operation of projects, to place CERP in best possible position to deal with future uncertainties
- Learning: Maximize opportunities for learning, in project design, implementation, operation, monitoring & research in CERP
- Communication: Maximize coordination & integration among managers and scientists
- Adjustment: Use new information to refine and improve the predicted & actual performance of CERP, in the context of the goals of the Plan

SAJ definition for Florida

Draft Monitoring & AM framework (provided to PDT from Stakeholders)

- Acknowledged that AM is used to mean various things
- In response to feedback (e.g., monitoring), objectives but not goals may be modified
- Recognizes that knowledge is uncertain and systems may not behave as predicted
- AM will be implemented if
  - specific restoration standards are not met, or
  - Actual conditions diverge sufficiently to threaten achievement of goals
- AM actions could include vegetation management, predator management, topographic modifications (i.e., channel modifications, levee modifications).

Draft Monitoring AM Framework

- Corps will monitor for 13 years after construction is completed
- “Adaptive management” will be implemented if, at any time during the monitoring, features are not performing as predicted
- Expectation for details of AM plan to be further developed

Draft Monitoring AM Framework

- Monitoring mandated for biological, hydrological, topographic, bathymetric and water quality.
- Biologically important
  - Basic coastal salt marsh function
  - Birds: winter use should be similar to that of nearby reference areas
  - Fish: ‘general suitability”
  - Endangered spp.: extent of suitable habitat and presence (Clapper rail, salt marsh harvest mouse)
  - Benthic macroinvertebrates. Appropriate colonization during first year

Implementation of HWRP AM

- Upland and intertidal
  - Not novel, suitable for established monitoring and adjustment.
- “Seasonal wetland”
  - Original concept: unvegetated areas with ponds ranging from brackish to near freshwater
- Risks of seasonal wetland
  - Do not exist in nature (some aspects of their function do).
  - Experience suggested that original “site vision” had considerable risk of not being met.
  - Engineering risks: “might not hold water”, subsidence
  - Biological risks: invasive species, predator access
  - Sea level rise

Implementation of HWRP AM

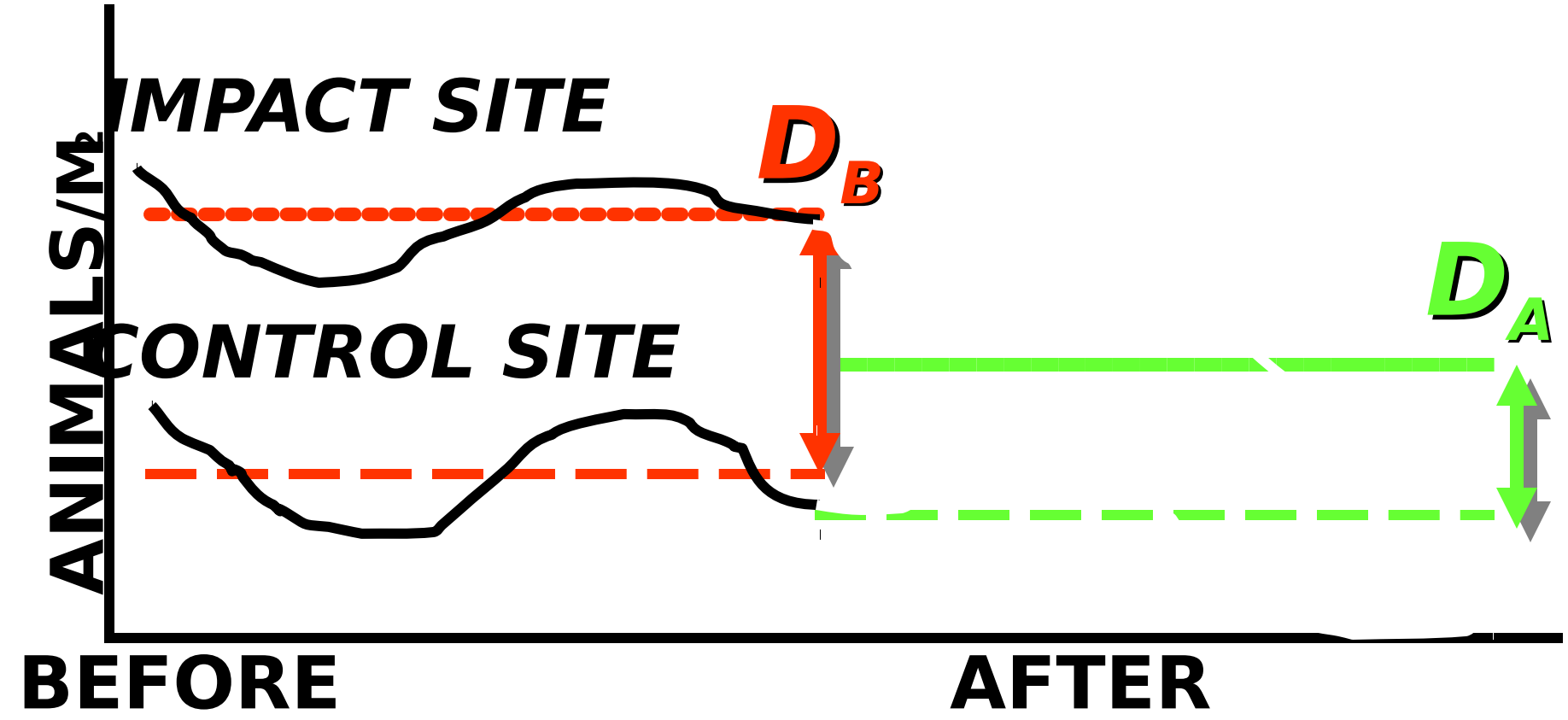
- Working adaptive management plan
  - "Research" approach
    - Suitability of plant species, will use field surveys to narrow down plant selection. Originally conceived of as test plantings of several species.
    - Study of bird populations in relation to water depths, timing of tides, etc. at multiple reference sites
    - Results will be used to fine-tune final design and serve as the basis of a "Beyond BACI" monitoring plan

Implementation of HWRP AM

- Working adaptive management plan (continued)
- Adaptive management available actions
  - Bird use: Ability to vary pond inundation areas, depths, times in response to built into system
  - Vegetation: Ability to vary salinity to enhance or inhibit certain species
  - Conventional management for respective habitats (weed control etc.)

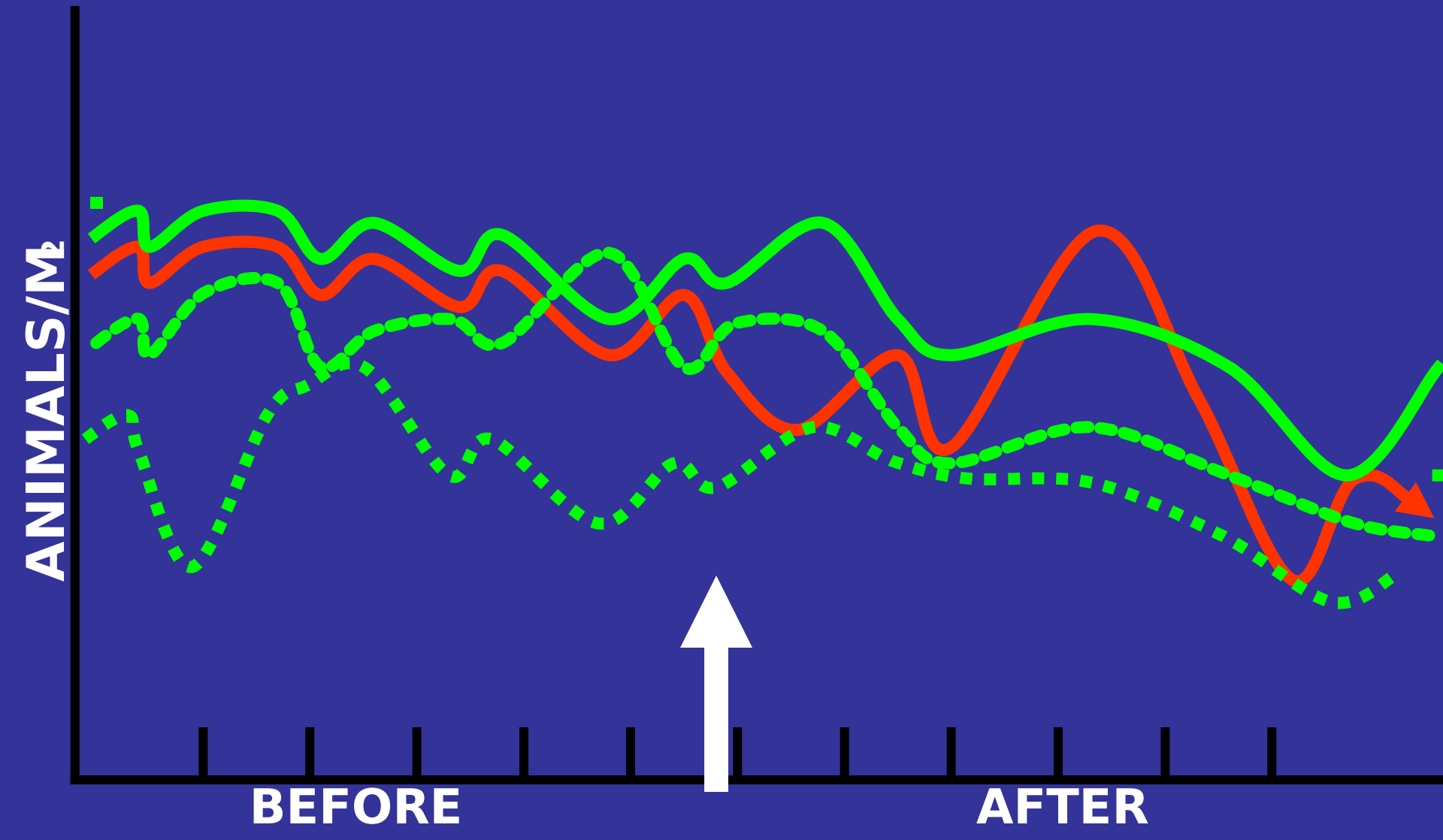
Before vs. After, Control vs Impact:
BACI

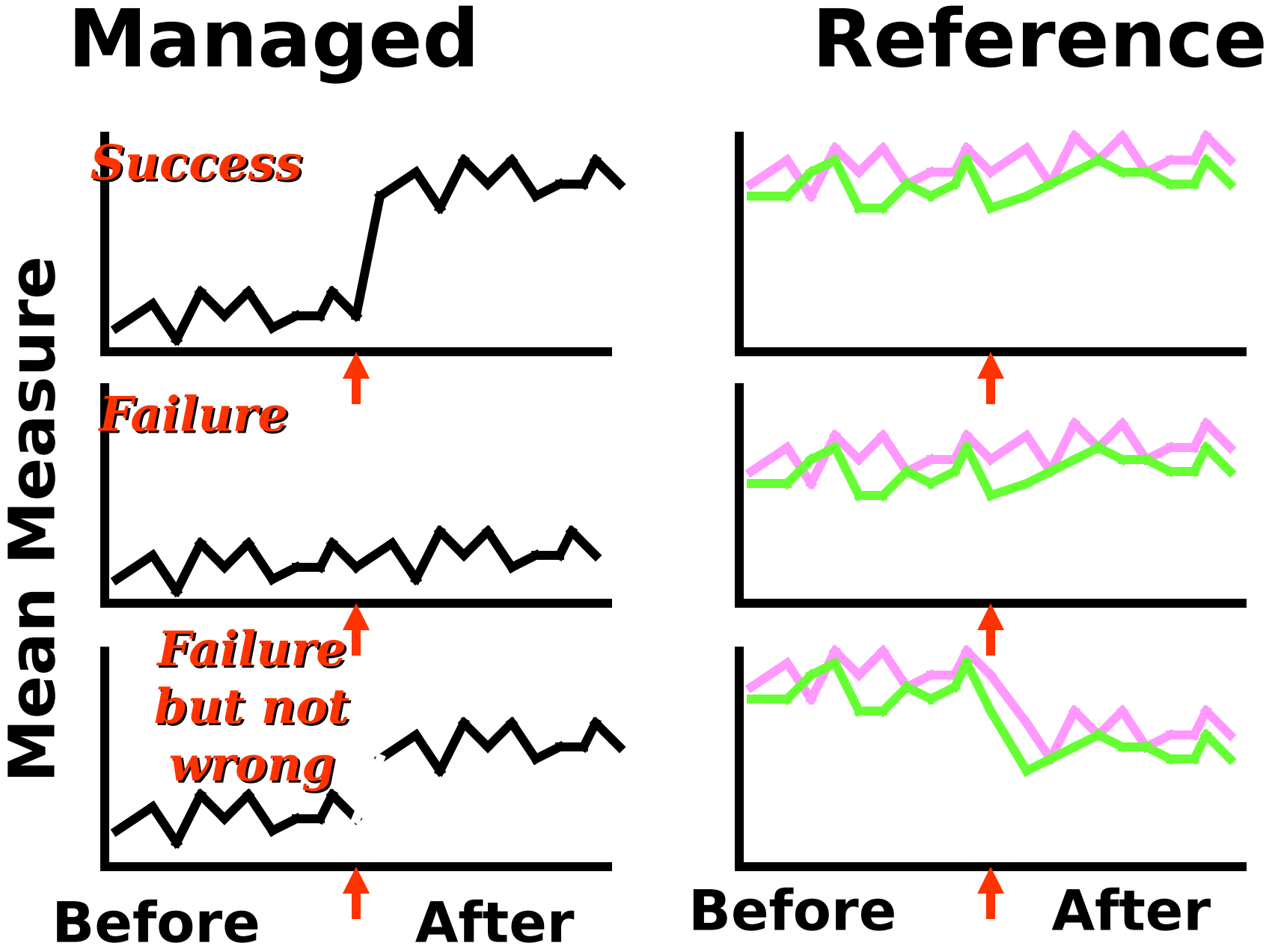
ASSUMES LOCATIONS CONTINUE TO DIFFER IN THE SAME WAY AFTER DISTURBANCE



“Beyond BACI”

Accounts for differences in multiple control sites




Managed
Reference
Success
Failure
Failure but not wrong
Mean Measure
Before
After
Before
After

Status of AM Plan

- Draft form, but has gone through various iterations for engineering/physical science inputs.
- Revised objectives, monitoring, success criteria, and AM plan dependent on ongoing work.
- Final AM plan due to agencies 12/07

AM in Corps Ecosystem Restoration Projects?

- Commit upfront to level of AM
- AM is integral to many sorts of Ecosystem Restoration projects
- Realize that AM plans need several iterations
- Adjust “success criteria” to multiple reference sites and “Beyond BACI” analyses